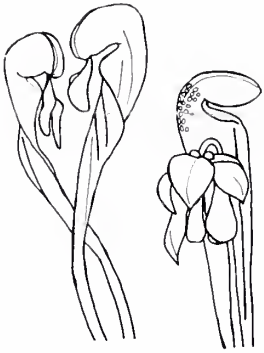
CARNIVOROUS PLANT NEWSLETTER

VOLUME 7, Number 1 MARCH, 1978



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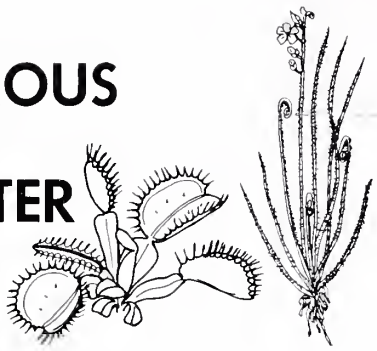

Volume 7, Number 1
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Cover

Nepenthes alata from near Quezon City (near Manila), Luzon Island, Philippine Islands. This easily grown species is part of the CP collection at the California State University, Fullerton greenhouse. *N. alata* is a highly variable species. This plant has pubescent pitchers and is planted in a one gallon container which is about 7 inches/ca 18 cm. high. Photo by L. Song

SPECIAL NOTICE

The co-editors of CPN would like everyone to pay particular attention to the following policies regarding your subscription to CPN:

All correspondence regarding subscriptions, address changes and missing issues should be sent to Pat Hansen, c/o The Fullerton Arboretum, Dept. of Biology, California State University, Fullerton, CA 92634. DO NOT SEND TO THE CO-EDITORS. Checks for subscriptions and reprints should be made payable to THE ARBORETUM FOUNDATION FUND.

All material for publication, comments and general correspondence about your plants, field trips or special noteworthy events relating to CP should be directed to one of the co-editors. We are interested in all news related to carnivorous plants and rely on the membership to supply us with this information so that we can share it with others. Comments on the new format will be greatly appreciated.

Names and addresses of the publisher and the co-editors will be found inside the front cover of each issue.

Views expressed in this publication are those of the authors, not necessarily the editorial staff.

Copy deadline for the June issue is May 1, 1978.

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Editor's Corner

What a difference a year makes. We begin this, our seventh year, with a completely new format and our first color plates. This change was made possible through a joint effort between the Co-editors and staff representing the subscribers and Kandid Litho Company, San Gabriel, California. Pat Hansen, our secretary-treasurer, who has done such a tremendous job this past year, will continue her fine work.

Many projects are in the works for the coming year. One of them will fill a need for better communication between CPN'rs who may live on the same block and not know of each other's existence.

We also hope to begin a continuing series on a detailed description of each species of CP somewhat in the style Don Schnell used in his book. This would include scientific and common (where known) names, range, general cultivation requirements, flower season, trap season and type, dormancy requirements, etc. It is hoped that we can release them as soon as they become available. At the present time, it is planned that they will be released as a looseleaf supplement to be placed in an easily obtained binder with subsequent descriptions to be filed alphabetically.

The Seed Bank has been very successful. Keep those seeds coming. Since this is a service for subscribers only, a list is sent to Pat Dwyer. Since new subscribers may want to order seeds as soon as their first issue is received and their name may not have reached him, the mailing label should be used for verification.

In closing, we would like to encourage you to communicate with us your ideas and/or criticisms, articles, to use and support the various subscriber services and to bear with us when the inevitable "bugs" crop up. Also, try and spread the good word.

Seed Bank

PATRICK DWYER, Director, St. Michael's Episcopal Church Gardens and Arboretum, 49 Killean Park, Albany, NY 12205, reports that the Seed Bank has been very successful. As of December 1, 1977, he has received $266.70 from seed orders; after expenses, $215.67 was contributed toward the publication of CPN. As of January 30, Patrick reports 32 donors of 2776+ packets of seed, and he has answered 211 letters!

There have been several suggestions for the seed bank, one of which is to include the name of the donor on each packet. This information, including habitat, date of harvesting and cultivation aids, will be sent with the seeds only if requested. Any donor not wishing his or her name given out must notify Patrick.

The Seed Bank needs as much seed as you can spare. All species, but particularly the rarer ones, are needed. Many thanks to those persons who have supported the Seed Bank!

DONORS	# PACKETS
J. Mazrimas	681
B. Hanrahan	605
C. Bramblett	265
D. Schnell	228
J. Brodie	194
B. Gardner	111
R. Frenzer	110+ (Not all counted yet)
P. Thomas	106
L. Song	60
P. Taverna	45
B. Muller	34

R. Riedl	34	M. Levy	11
C. Palmer	33	D. Graber	10
B. Augustine	32	G. Nolan	10
S. Rehder	32	J. Van Dyke	7
J. Korolas	30	S. Richardson	6
J. Kwan	24	W. Greenwood	3
S. Olejnek	24	P. Ware	2
L. Mellichamp	23	S. Henderson	2
P. McLaughlin	20	R. Phillips	2
O. Tallman	20	A. Bendorf	+ (not counted yet)
P. Dwyer	20		
D. Taylor	16	TOTAL = 2776+	

SEED BANK INVENTORY
January 26, 1978

Cost: $.50 per packet.
Please list substitutes.
Byblis liniflora, Darlingtonia californica, Dionaea muscipula, Drosera aliciae, D. aliciae (pale flower) 14*, *D. aliciae* (purple flower) 10, *D. anglica, D. binata* 7, *D. binata hybrid* 1, *D. burmannii, D. burmannii* (Australia) 1, *D. burmannii* (Taiwan) 1, *D.* x *californica* 9, *D. capensis, D. capensis* (narrow leaf), *D. capensis* mix (normal & narrow), *D. capensis* (narrow) & *D. capillaris* (long) mix 4, *D. capillaris, D. capillaris* (long leaf) 13, *D. filiformis filiformis, D. indica* 12, *D. indica* (white flower) 5, *D. intermedia, D. montana* 3, *D. natalensis, D. paleacea* 1, *D. peltata* 6, *D. planchonii, D. pulchella, D. rotundifolia, D. rotundifolia* possibly mixed with some *D.* x *obovata, D. spathulata, D. spath.* (Kanto type), *D. spath.* (Kansai type), *D. spath.* (Australia), *D. spath.* (rotundate - Japan) 4, *Drosophyllum lusitanicum* 15, *Nepenthes burkei* (?) x *superba* 5, *N. khasiana, N. mirabilis, Sarracenia alata, S. alata* (x-ray 100 rads), *S. alata* (x-ray 550 rads) 10, *S. flava, S. flava* (copper lid) 14, *S. flava* (red veined) 2, *S. leucophylla, Sarracenia leucophylla* (x-ray 100 rads) 3, *S. minor* 8, *S. purpurea* 4, *S. purpurea purpurea* 14, *S. purpurea ripicola, S. purpurea venosa* (x-ray 100 rads) 6, *S. purpurea venosa* (x-ray 550 rads) 1, *S. rubra* 2, *S. rubra* (Gulf) 2, *S. rubra* (Savannah) 11, *S. rubra alabamensis, S. rubra jonesii, S. rubra wherryi* 2, *S. alata* x *leucophylla* 11, *S. alata* x *leucophylla* (?), *S.* x *cateshaei, S.* x *chelsoni* 3, *S.* x *harperi, S. leuco.* x *willissi* 1, *S.* x *mitchelliana* 8, *S. rubra* x *leucophylla* 3, *S. rubra* x *purpurea* 3, *Sarracenia* mix, *Utricularia lateriflora* 1, *U. longifolia, Utricularia montana, U. nephrophylla* 1, *U. racemosa* 1, *U. subulata* 4.

*Number of packets is listed if there are fewer than 15.

Seed Bank orders and contributions should be addressed to Patrick Dwyer.

To send seed: Please remove seed from the seed capsules and place it in small envelopes (preferably paper so that they dry out enough to prevent mold). Label with the origin and date of collection, including habitat if it is exotic. Fold the envelope over once or twice before taping so that the seeds don't stick to the tape. After the seed is received it will be placed in smaller packets; donors will be informed of how many packets they have donated. A donation of 10-19 packets earns one free seed packet of comparable rarity, with one free for each additional 10 packets.

Do not ask to trade for seed from the bank. Everyone will have to buy all but their free packets. When you send seed, indicate whether it is for the seed bank, for Patrick's seed project or for a personal trade. The seed bank is separate from his collection.

To order seed: Please enclose payment. List the seeds desired and an equal number of substitutes in order of preference. If requested, Patrick will add any cultural instructions of which he is aware. Patrick will answer all letters and orders as quickly as possible; if you receive no response within two weeks (U.S.) to a month (outside U.S.) please write again. Each issue of CPN will include an update of the inventory.

News and Views

SCOTT BENNETT (517 E. State St., Ithaca, NY 14850) writes: The Mexican Pinguiculas are growing really great in my bedroom greenhouse. I built a bed up on stilts — it's actually a free-standing structure that is box-like and built from 2 x 4 inch lumber. My plants are growing underneath this structure under 4 ft. fluorescent fixtures. They are doing great!

DON BURDEN (Rt. 3, Box 219, Floyd Knobs, IN 47119) writes that regarding the seed bank, he believes there would be a higher seed supply if competition could be created. One idea is to award a free volume of CPN for the next year to the two people who have sent in the most seed packets during the past year and to the two people who have sent in seed from the most diverse number of species during the past year.

Secondly, he would like to warn about the mislabeling of *Nepenthes*. In early 1976 he sent for a *N. dicksoniana* from Marcel Lecoufle. The plant he received was labeled *N. dicksoniana* but was later identified as a *N. kampotiana* by Barry Brooks. Upon further correspondence with Lecoufle, the mislabeling was reportedly done by a botanic garden where Lecoufle gets the *Nepenthes* cuttings to root. Lecoufle had also tried other botanic gardens for the *N. dicksoniana* but was unsuccessful.

JOSEPH P. CANTASANO (2717 Jerusalem Ave., N. Bellmore, NY 11710) writes: Some readers might find this interesting. I gave a friend one of my *Nepenthes ampullaria* which he took home, and as he pulled away some of the sphagnum moss, he found a colony of black ants living in the moss. I also found colonies of black ants living in most of my pots, too! He also found two rosettes with two inch white pitchers filled with these ants. He could also see the digestive glands throughout most of the pitchers. I am wondering if any CPN readers found *N. ampullaria* pitchers growing under the moss.

Some CPN readers who live in cold climates might be interested in this energy-saving idea. I read an article in the December issue of *Organic Farming*. This article explored the idea of using mulch as a means of heating a greenhouse. By placing mulch and fertilizer in a wire basket that is approximately 9 cubic feet and keeping the mix damp, the process of decay and ensuing bacteria produces steam and heat. This could raise the temperature in a greenhouse to 90°F and produce a tropical atmosphere with close to 100% humidity even on a cold and cloudy day. This steam and heat has an estimated lifetime of three weeks. By continuing to add mulch and fertilizer to the original mix, the production of steam

heat become more efficient. The wire baskets can be placed beneath the benches or anywhere where there is unused space. Hopefully, this process will prove beneficial to all my CP and also lower the cost of heating my greenhouse. I will let you know how things turn out.

I would also like to share this information with CPN readers. In the early spring of 1976, I started a bed of *Dionaea muscipula* seeds and plants in a sphagnum bog here on Long Island. I also planted many *Sarracenia flava* plants and a few *Drosera capensis*. Running through this bog is a brook that does not seem to ice over even during very cold weather. I planted all the plants along the bank of the running brook. By the middle of June, all the fly-traps and *S. flava* sent up flowers, and *D. capensis* were also doing nicely. It seemed that all the plants were adapting to the bog and the Long Island summer climate. Of course, the real test will come this spring. If all the plants are still doing well, I will plant *Cephalotus follicularis* and *Darlingtonia californica* in the bog this spring. Native plants growing in this bog are *S. purpurea, D. capillaris, D. filiformis, D. intermedia* (which is over nine inches tall) and *D. rotundifolia.*

ROBERT GRIESBACH (404 S. Cumberland, Park Ridge, IL 60068) writes: Apparently there exists more than one unusual form of *Sarracenia purpurea* ssp. *purpurea*. Besides the more common heterophylla type, a solid red type also exists. This type is slightly rarer than the heterophylla type. Comparative culture techniques do suggest that this variation is genetic, not environmentally produced. I would be interested in hearing from anyone who has come across this variant.

DAVID M. HORAN (1705 Magnolia Lane, West Palm Beach, FL 33409) writes: I have one *Nepenthes kampotiana* growing in a 7-inch pot outdoors under a lath along with my orchids. I use only rainwater and no fertilizers or insecticides are applied. For a potting medium, I use osmunda mixed with sphagnum moss. In January, 1977, the temperature dropped to 25°F, and the plant suffered freeze damage but did not perish. I took several cuttings which rooted and are now growing satisfactorily at this time. I was surprised that this tropical plant survived a "hard freeze."

LARRY MELLICHAMP (Dept. of Biology, UNCC, Charlotte, NC 28223) writes: This seems to be a good time to think about conservation. More and more is being heard about it in the media, and I am sure many people who are concerned are interested in knowing more about the facts and the background involved with the decisions regarding the endangered or threatened status of many of our native plants. Carnivorous plants are among the most important, conspicuous, and well-known-to-the-public of any of the plants on the various proposed protection lists. While not all CP are rare and endangered, some significant ones are. In light of the fact that many more people than ever before collect these plants as a hobby, we feel it is important that all of us understand the situation surrounding the designation of these plants as rare and endangered.

Perhaps soon we will have a detailed summary of the status of rare and endangered CP here in the pages of CPN. Right now, however, we would encourage readers to obtain, read and understand as much on the subject as possible from all available sources; you can never know too much about this topic. In the Literature section of this issue of CPN are listed three recent publications dealing with rare and endangered plants. Read the summaries and try to obtain the material from the sources indicated if you are interested in opening the doors to finding out more about this interesting, important subject.

GARRY NOLAN (20 Stratford Court, Windsor, CT 06095) writes: Did you know that a fruit fly culture, if not carefully maintained, will spoil, run out of nutrients, and soon become contaminated by wild-type *Drosophyllum?* What a great new way to propagate *Drosophyllum;* just don't let Louis Pasteur hear about it. I refer to your indexing mistake of Volume VI; under the generic heading *Drosophyllum,* you refer to page 9 of Volume VI, which mentions only the common fruit fly, *Drosophila.* (*Oops.* Ed.)

I was wondering if anyone has had any success with the use of colchicine on CP. Colchicine, when applied correctly and in the proper concentration, promotes chromosome doubling, called polyploidy, in plants. This often leads to stronger, larger plants with much more resistance to disease. Care must be taken with this chemical, especially when it comes to the propagation of the polyploid individuals. These plants are no longer the same species; they usually have twice the normal number of chromosomes, although they are similar in appearance to the parent plant.

Another interesting use of colchicine is in plant breeding. Assume you have a normal plant on which you wish to experiment; its chromosome number is generally diploid. You apply chochicine to a growing stem and after the stem has grown a little more, you take a cutting *above* the place where you applied the colchicine. This cutting, if the experiment has worked, is a tetraploid individual. When both the tetraploid and diploid plants flower, cross them, and you will obtain a triploid plant. The triploid plant is usually sterile; problems occur in meiosis with odd-numbered sets of chromosomes.

You can even double the tetraploid to obtain an octaploid. From there a 16-ploid, although the agricultural benefits have usually played out before 16 sets. I would like to hear from people who have had success with colchicine used on CP. It's a very interesting subject in plant genetics. There is much literature on the use of colchicine and its benefits to agriculture and genetics. I hope this letter will spark the interest of some who would like to experiment in this intriguing field.

We have a World List of carnivorous plants, now how about pictures to go along with the names? There is presently, to the best of my knowledge, no book or work that devotes itself wholly to the chore of complete classification of carnivorous plants. A small booklet could be set up, *Exotica* in style, with photographs contributed by CPN readers. Such a booklet could greatly alleviate the many problems one faces when attempting to classify a plant. It would also abrogate the necessity of owning several, or more, books neded to approach the problem of classification.

To offset the cost of such a venture, CPN, or whoever happens to undertake the task, could charge for the booklet. I'm sure there aren't many people who would mind paying. The complete booklet could be printed on the same type of paper as is CPN, with pictures reproduced in the same fashion as normally. The name of the plant, with native habitat(s) and coded cultural instructions, could be placed directly beneath the picture. Twenty pictures could fit comfortably on a page, with the total booklet comprising less than thirty pages!

I hope someone, CPN or a person approved by CPN, decides to undertake this task; it would be of great benefit to all of us. After all, what are names without a face?

DON SCHNELL (Rt. 4, Box 275B, Statesville, NC 28677) writes: A recent short article by Steven W. Leonard in the *NC Wild Flower Preservation Society Newsletter* (Fall, 1977, pp. 26-28, no vol. designation) described the author's

discovery of *Dionaea muscipula* growing in a savanna in Franklin Co., Florida, some 500 miles disjunct from its present range. There were 86 plants counted along with some seedlings, and the mature plants were flowering. However, careful search of the rest of the savanna and several others close by failed to disclose additional stands, leading to the suspicion that perhaps these plants had been introduced and had naturalized remarkably well in a habitat very similar to its native Carolinas habitat. There is no record or knowledge of who may have made the introduction among regional botanists. (Ed. note — we have deleted the exact location for obvious reasons).

PHILIP SHERIDAN (5729 S. 2nd St., Arlington, VA 22204) writes that he found another source of live sphagnum, the Tote Em in Zoo, Wilmington, NC. The cost is $5.00 per bushel, shipping averaging $2.00 by UPS. Philip's local CP club is going to make bumper stickers, funds going to the club treasury. They will be: "SOS — SAVE OUR SWAMPS — GREEN SWAMP, NC" and the cost is $1.50 each (send your order to Philip). His club also plans a June trip to the New Jersey Pine Barrens, and those wishing to join the outing should write Philip for additional information.

SUSAN SIKES (180 No. Fourth St. #501, San Jose, CA 95112) writes: After reading all six volumes of CPN, I found no one had mentioned a good source for distilled water for watering CP. I save the water that melts from the frost in my refrigerator when I defrost. I have used it successfully for several years. Usually, I use the water at room temperature. On the hottest days last summer, I cooled some in the refrigerator and poured it around the roots of my *Darlingtonia californica*. It came through the summer quite well.

TOM STORY (1801 Cavallo Road, Antioch, CA 94509) writes: As a beginner I would like to mention a few things that I would like to see expounded upon in the Beginner's Corner. One is a roundup of information, now scattered through the six volumes of CPN, on insecticides, miticides, fungicides, and other pest treatment chemicals whose names have come at me in all directions. In CPN Vol. 2, p. 53 you gave a list of CP names and meanings; one-third of these are still somewhat unfamiliar to me — thus these names and short descriptions and the locations of these types would be informative to beginners.

More from TOM STORY: I recently rescued a flytrap from my neighbor which was withering away; it is now prospering in my terrarium. It really brought home the point to me that few of these delicate plants have a chance of survival with the casual houseplant collector. My first terrarium with this new addition is now filled to capacity, thus I acquired another and look forward to spring when they perk up again. I discovered a way to make a small inexpensive terrarium by taking a gallon wine jug and halving it with a readily available bottle-cutting outfit (Avalon Industries, Inc., Hobbycraft Div., 95 Lorimer St., Brooklyn, NY 11206). They are very attractive and also help ecology by recycling.

I would like to relate some more thoughts I had on CPN, some of them brought to light by the last issue. I am looking forward to seeing the new format and improved picture quality the change will bring, though it seems to me that as more pictures are printed it will sacrifice letters and notes that would otherwise have been published. These have been at times very interesting and informative, as well as keeping the issues on a personal level. I hope an effort will be made to preserve this aspect of CPN. Something else along with the change in format that could be added is membership cards.

These could provide subscribers identification that might allow them entry into areas of botanical gardens containing CP exhibits that I understand are sometimes closed to the general public; other advantages could come up as well. World Insectivorous Plants wrote me that they give tours, but to CPN members only.

In closing I would like to warn all CP growers who have cats of an experience that happened to me lately. As my cats regularly use a catbox of kitty litter, they apparently recognized my terrarium (which I had inadvertently left uncovered) as a catbox and used it as such, with the disastrous result of destroying many of the plants with either urine or burial.

Due to the newsletter status of CPN, the last issue brought to light something that is glaringly absent from CPN. A paragraph mentioned the Flower Show at the San Francisco County Fair, which I would have attended, especially since CP were exhibited there. The news of this or any other event was never noted in your last issue. This type of news is of special interest to all who subscribe. Please consider adding this information to future issues.

(Information on the S. F. Show was not available to CPN at press time, especially in relation to having CP shown or judged. When information on future shows is sent to us well in advance of press time, we will gladly publish all the relevant information for our readers to take advantage of such events. Another CP showing will be taking place at the Oakland Flower and Garden Show at Lake Merritt in Oakland, CA, at the end of April and the first week in May of this year. I hope to see all of you CP buffs in the area at the show. Ed. J. A. M.)

RHONDA STRICKLAND (The Sand Castle, 1776 E. Jefferson St., Rockville, MD 20852) writes: You may want to mention The Sand Castle in your newsletter as an additional source of CP's to Washington, D.C., collectors. We have been growing and selling *Dionaea, Drosera* and *Sarracenia purpurea* for a year now, and I am pleased to see how interested people in this area are. We will be in the World of Plants and Flowers Show at the Capital Centre March 8-12 and will have a display of Carnivorous plants.

Good luck with your great newsletter. I will be looking forward to seeing the new format and will continue to encourage newcomers to the CP hobby to subscribe to your excellent publication.

Round Robin Letter Exchange

TERRY BROKENBRO (37 Laburnham Gardens, Upminster, Essex, RM14 1HX, Great Britain) started this letter exchange to help CPNers with similar interests to correspond with one another and also supply a future information source for publishing in CPN. Anyone interested in joining the exchange should write to Terry first enclosing details of CP that they are interested in. The rules are as follows:

(1) All CPN subscribers are eligible.

(2) Send full details of particular interests (e.g. *Nepenthes, Drosera, Pinguicula* or CP in general). Even if there is a particular interest in one species (e.g. *Drosera binata* complex) this should be mentioned so that if the demand is great enough, a R.R. could be started just for this.

(3) Each Robin would consist of approximately 8-15 participants, although more than one R.R. can be set up for any one subject.

(4) CPN subscribers may join as many Robins as they wish.

(5) R.R. participants should realize that in fairness to others, they should not join when there is a possibility of having to cease correspondence after a few months due to personal circumstances.

(6) Upon receiving correspondence, this should be read and passed to the next participant as soon as possible in order to have an uninterrupted flow. Participants are invited to add any comments or information to the letter, or they may choose to just pass it on to the next person on the list with a suitable explanatory note.

There are already four R.R.s in operation now: Seed germination, *Drosera, Nepenthes* and General subjects. Terry has ten more Robins waiting for more participants who are interested in any of the topics listed below. He advises that they write immediately to ensure a place on the appropriate listing. Numbers following the title indicate participants already signed up.

Pinguicula (3), *Sarracenia* (5), *Darlingtonia* (4), *Cephalotus* (5), Pygmy *Drosera* (4), *Heliamphora* (4), *Nepenthes* II (6), Tuberous *Drosera* (4), *Drosera* II (5), Seed Germination/Raising (3).

Heliamphora nutans
Photo by Joseph A. Mazrimas

Heliamphora minor
Photo by Joseph A. Mazrimas

Short Notes

The Uptake of Digestion Products by *Drosera*

By Dr. Graeme Chandler

Carnivorous or insectivorous plants have long been suspected of supplementing their nutrition with insects or other prey which are initially lured to the plant with the aid of some attractant, captured and digested. The metabolites released by the action of this digestion process are absorbed. As a result of the proteinaceous material and other nutrients derived from the insects the plant tends to flourish. Theory has it that carnivorous plants inhabit wet and swampy areas where nitrates especially are low in both availability and total amounts and hence the heterotrophic habit by-passes the absorption of many compounds via the root system.

Taxonomically, carnivorous plants can be classified into six families and fifteen genera, several of the genera also being contained exclusively to the Australian mainland (*Polypompholyx, Byblis,* and the W. Australian pitcher plant *Cephalotus.*) The most common type of trap is that of the pitcher which is found in five genera and is typified by *Nepenthes.* The outer wall of the *Nepenthes* pitcher is often covered with glands secreting nectar-like substances which act as a lure to ants. The sticky flypaper traps characteristic of *Drosera* are also common and this is probably the genus many of you will have seen around Melbourne itself. The active mousetrap of *Utricularia* is confined to watery localities and it operates with an inflation-type movement such that prey are actually sucked into the trap from whence they never return.

There are 500 species or more of CP, and this number is still increasing in number. Australia is heavily infested with *Drosera* although distribution is worldwide.

In a physiological context, plants can be deemed heterotrophic or carnivorous if three essential criteria are fulfilled:
a) Plants must lure, entrap and hold onto the prey.
b) The plants must possess some mechanism for absorbing metabolites of animal origin and as a corollary, if the prey is composed of polymeric (large complex molecules made up of smaller units) metabolites, there must be some mechanism to digest these metabolites to monomeric units suitable for absorption. For example, proteolytic enzymes may be synthesized to break down proteins to amino acids or peptides which can then be absorbed.
c) Once metabolites of animal origin are absorbed, they must be utilized for growth and development.

These three criteria must be fulfilled because there are many mimics of carnivorous plants (e.g. *Roridula*). Only 15 genera of plants fulfill these three criteria and among these are *Drosophyllum, Pinguicula, Utricularia* and *Drosera,* etc. The difficulty of proving that a plant fulfills the third criterion possibly stems from the difficulty of culturing some carnivorous plants.

Studies with *Drosera* began possibly before the time of Darwin (1875). Darwin, however, observed that the application of insects to the leaves of *Drosera* led to more vigorous plants producing greater numbers of inflorescences and more seed than plants not supplied insects. Although the number of papers published on the subject of *Drosera* is

large, there are in fact very few critical experiments to substantiate the conclusion that *Drosera* species can supplement their nutrition with insects supplied to the leaves of the plant. For example, a convincing statistical experiment describing enhanced growth of *Drosera* following the controlled application of insects has never been performed. As a consequence of this, our first approach in looking at the heterotrophic nutrition of *Drosera* was to grow *D. whittakeri* in sand cultures under regimes deficient in nitrogen and phosphorus to determine whether or not the nutrient deficiencies could be offset by suppling anesthetized insects, i.e. the fruit-fly, *Drosophila melanogaster,* to the leaves. Plants were arranged in a randomized block design in groups of 10 plants per treatment (i.e. per tray). The whole array of trays was covered with a muslin canopy. After two months, the plants were harvested and their dry weights estimated and analysis of variance was carried out.

Plants not supplied with insects but grown under full nutrient conditions exhibited average dry weight increases of 20 mg/plant. The dry weight of plants grown in nitrogen deficient medium (without insects) was significantly different from plants grown under full nutrient conditions but not significantly different from plants grown in the absence of nutrient salts (no insects). This implies that nitrogen stress was an important factor in limiting growth in these plants. Supplying insects to these plants at the rate of one fruit fly every week after removing the dead carcass of the previous week increased their dry weight significantly suggesting that insects were being utilized as a source of nitrogen. Unfed plants grown in full-nutrient regimes did not exhibit greater dry weight increases than plants grown in the same medium not supplied insects, indicating that the heterotrophic nutrition may be advantageous only under conditions of low nutrient status.

I should remind you that when referring to full nutrient medium, we really mean a 1/10 strength solution described by Shive and Robbins so that the amount of nutrients available is not all that great and even at this low level, insects did not increase the dry weight over that attributable to the nutrient solution. We do not know, of course, whether the insects or the nutrient solution are utilized first and maybe the actual maximum growth potential was not realized because of culture techniques or something.

Withholding phosphorus from the nutrient medium did not significantly affect the dry weight increase of plants growing in this medium. Plants growing in phosphorus-deficient regime and supplied insects did not exhibit dry weight increases compared with plants grown in the same regime not supplied insects. Phosphorus cannot be a limiting factor in the growth of these plants.

Drosera whittakeri, the plant used in this growth experiment, does not set seed, and this necessitated the use of plants grown from tubers. Sufficient numbers of plants were collected after the appearance of the rosette above ground level and the tuberous plants used. In trying to explain the lack of response to phosphorus stress, we examined the tubers of *D. whittakeri* for phosphorus content from the time of emergence until senescence in mid-November. The phosphorus content of the tubers initially was around 35 micrograms tuber. The phosphorus content drops initially and the loss of phosphorus from the tuber is observed in the aerial parts of the plant. After the initial loss of phosphorus at the start of the growing season, the phosphorus level increases slowly and reaches approximately the initial level at the time the plant senesces. The tuber over-summers and then germinates with the onset of rains in May.

At the time of collecting our material for the growth experiment, although the

aerial parts of the plant were not extensive, they already contained much of the phosphorus necessary for full growth and development. It may be necessary to grow *D. whittakeri* in phosphorus-free soil for several generations if the phosphorus story with insects is to be resolved. I do think, however, that insects will play an important role in the phosphorus nutrition of this species. This suspicion is enhanced by the data obtained for plants of *D. whittakeri* which put out lateral stems. Lateral stems form in the tubers at the end of the growing season and so this is a form of asexual reproduction in this species. Plants producing lateral stems have a much higher total phosphorus level than plants not producing lateral stems and at senescence are left with two tubers with a total phosphorus content of 80-100 micrograms. Hence, wheatgrowers using *Drosera* have both an automatic insecticide system as well as an automatic phosphate fertilizer system all in one. The form of phosphorus was investigated and found to be organically bound in inositol hexaphosphate, i.e. phytin.

A similar growth experiment was carried out again using *D. whittakeri* except that a sulfur-deficient medium was used. The results confirmed the previously described experiment, i.e., there was no enhancement of growth under full nutrient conditions when insects were supplied. There was enhancement of growth in the distilled water and nitrogen deficient media when insects were supplied.

(To be continued)

Propagating *Nepenthes* with Maximum Efficiency

by Richard Sivertsen
(309 96th St., Brooklyn, NY 11209)

Lately, within the last few years, an increasing demand for *Nepenthes* has become evident. In fact, it seems that a revival of the Victorian botanical movement has occurred. A few commercial sources are available but prices are often discouraging to many beginners.

The conventional method for producing new plants by rooting stem cuttings, often in excess of 3 or 4 nodes, some over 6 nodes per cutting, is considerably inefficient in view of the fact that each node is potentially a new plant! To complicate matters a little, if a few of these cuttings do not root well, or just rot instead, it is all the less efficient and fewer plants are available, driving the prices of the remaining plants still higher. Furthermore, if and when the conventional cuttings root, the new roots must support often more than one new stem when more than one axillary bud becomes activated; this puts a considerable amount of strain on the newly developing root system. Then the nutrients must travel from the new roots (on the old stem) up through the old stem, and across a vascular tissue "bridge" to support the new stem developing from the axillary bud. The ideal situation would be to have roots directly from the stem which it supports. But this involves raising plants from seed, or a technique that I have been developing over a period almost two years on various plants (*Nepenthes* and non-CPs).

If commercial sources were able to turn out many more plants, then hopefully the prices would drop down according to the law of supply and demand. Then perhaps more beginners would be able to get a chance at growing *Nepenthes*, and possibly even get a chance to produce a hybrid or two! It would also be quite desirable if the commercial sources were to turn out healthier and more strongly rooted plants so that beginners might not become too discouraged by losing a plant or two that were relatively weakly rooted to begin with. Commercial sources on the other hand would be able to realize a greater

turnover with fewer losses from fewer stock plants which would occupy less greenhouse space.

First, remove the apical meristem (the tip cutting) by removing just 3 nodes under the visible top closed leaf. This part of the stem should be mature enough. Removing a cutting too close to the apical meristem may lead to complications as the stem is "soft" and immature and very susceptible to disease; also a hormone problem is involved. The concentration of hormones at the apical meristem is such that root development will be inhibited. I usually root this apical cutting in a usual manner in live sphagnum tips in a small, clear pastic cup with a drainage hole cut out at the bottom. This cutting can be difficult as the embryonic leaves occasionally develop a rot in 100% humidity. If such a rot develops, simply break off those leaves and remove them from the plant. The apical meristem may have to be removed if the rot becomes severe enough — but new stems will emerge from the existing lateral buds. Lowering the humidity a little on just these plants may be desirable to inhibit fungal infections. Unless absolutely necessary, I would discourage fungicide use as they kill the sphagnum.*

After a period of about two weeks, the original stock plant (with the apical meristem or cutting removed) will begin to activate one or more of the top lateral buds (on the stem, near the base of the petiole facing the leaf). If left alone, only a few of the temporarily activated lateral buds will develop fully into a new stem and assume dominance over the lower lateral buds. When the topmost bud develops just two "scale" leaves (without pitchers) that are about an inch in length, remove just that one node, along with the adjacent portion of stem by cutting the stem just above the next lower node (This is a leaf bud cutting. Ed.), and place it in a small pot (or plastic cup, styrofoam or clear plastic) containing live sphagnum preferably, burying the *entire old stem,* so that only the scale leaves protrude through the surface of the sphagnum-filled pot. The old leaf petiole on the stem may be cut to ½ its original length.

I prefer to root my *Nepenthes* cuttings in large (100 gal) fish tanks (or terrarium tanks) with a glass (or plexiglass) cover on top creating an atmosphere of 100% humidity. The pots stand on red bricks on the bottom of the tank, with a layer of water almost up to the top of the bricks but not touching the pots. The pots will seldom have to be watered in this tank after initial placement. The rooting cuttings can be illuminated by either fluorescent lamps, or *indirect* sunlight. Photo period should be between 12 to 16 hours daily. Caution: *Never* allow the tank of rooting cuttings to be exposed to direct sunlight with the cover on. In fact, it is best not to allow direct exposure to full sunlight at all. Direct sunlight would cause a "greenhouse" effect and dangerously high temperatures within a very short time. This accumulation of heat must be avoided. I have best results maintaining just room temperature (68° to 80° F) inside the tank. After two new pitchers are produced from the rooting cutting, a mild dose of fertilizer can be applied (about ½ the strength recommended by the manufacturer). As far as sphagnum goes — I recommend using the coarsest, densest strands available; the "coarser the better" is a good rule of thumb. I prefer live sphagnum over dried. However, some may prefer to use dried sphagnum for convenience or for sanitary reasons. I also recommend inorganic fertilizers as they

* In CPN 1(4):55 (1973) Henry Demmink describes a method of propagation *Nepenthes* that begins in a similar manner but differs in what happens to the rest of the stem after apical meristem removal.

have less chance of being contaminated with fungus or bacteria.

After three new pitchers are formed on the new growth, the plant is ready to be transplanted into a larger pot containing coarse sphagnum with 10% aggregate such as peat (again, I have best results with German Peat) or osmunda fiber, or fine tree fern fiber.

As each node of the original stock plant that you have "topped" (going down the stem) becomes activated enough so that it has produced two scale leaves, it can be removed (removing only one node per cutting) making sure that a conspicuously swollen node is left on the stem below it. There may be a point on the stem where the nodes may have difficulty becoming activated, especially on old woody stems. Leaving a swollen node behind each time will ensure that the stock plant can still recover, and produce another stem of its own. This cutting down of the stem, working off each node of the stem, occasionally causes the stem to produce a burst of basal rosettes that surface near or just below the surface of the potting medium. If this occurs, any remaining nodes that can be removed for rooting should be taken from the old stem, leaving behind basal rosettes to become future stock stems.

As the new cuttings mature, roots will eventually emerge from the bottom of the new bud stem, near the point where it grew out of the old stem. This will produce a healthier plant compared to conventional cuttings.

These single node cuttings seem to root quicker than conventional cuttings, too.

To sum up the process, we first remove the tip cutting (apical meristem) and then proceed to remove each node separaely as it becomes activated enough, leaving behind and below it one node which is obviously swelling in size, unless a basal rosette has surfaced from a lower portion of the stem, in which case the entire stem can be worked off. Each cutting is rooted in a separate container of coarse sphagnum. I prefer *not* to use *any hormones* or *fungicides* on these cuttings at all. They are all placed in large (100+ gal) glass tanks with a layer of water at the bottom. The small pots are elevated just above the surface of the water, and a cover is placed on top of the tank.

The cuttings will initially root from the old stem. However, as the plant matures, roots will emerge from the lowermost portion of the new bud stem; this is why this area must be below the surface of the sphagnum. I have been successful using this technique on: 1) *Nepenthes hirsuta,* 2) *N. spectabilis,* 3) *N. ventricosa,* 4) *N. albo-marginata,* 5) *N. dyeriana,* 6) *N. alata,* 7) *N. maxima,* 8) *N. tentaculata,* 9) *N. kampotiana,* and several common hybrids at a 100% success rate (no losses in two years). Caution must be exercised when dealing with plants that are still in juvenile form which have a very tightly compact basal rosette. I would recommend waiting until these plants are mature enough to produce an erect spike stem at least six nodes long (each node at least ½ inch in length) before attempting to implement this technique.

(Received January 20, 1978)

SPECIAL NOTICES

J. A. Mazrimas will be the coordinator of the CP Section at the California Spring Garden Show at Lake Merritt Park, Oakland. The show will run for 10 days beginning 28 April, 1978. Admission.

Lynn Macey of the Carnivorous Plant Information Service announces that by the time you read these words, the Plant List will have been sent out. If you ordered one and have not received it, please drop him a line. Also, send him your latest updates as soon as possible plus $1.00 if you want a copy of the list.

Beginner's Corner

by
L. Song

With this issue of CPN, we begin a series on the various aspects of propagation (the production of additional plants from a single plant by sexual and/or asexual means). We will start by defining some of the terms used and present some of the basic concepts of propagation. More details and specific information will be given in later installments where each genus and, if necessary, individual species will be discussed.

Sexual propagation is any method that would entail a rearrangement of the genetic material. In CP, this would be by seed. Asexual propagation would be methods that would maintain the original arrangement of the genetic material by using a portion(s) of the original plant for growing new individuals. Some examples would be leaf, stem and root cuttings, as well as simple division (splitting a clump of plants into separate independently growing portions). Newer techniques of cloning or asexual propagation, such as aseptic tissue culture (growing in test tubes under sterile or germ free conditions in a culture medium that supplies all nutrients and hormones) of the meristem (growing point) so commonly used in orchid and fern culture, have not been widely used in CP. More research is needed here.

Propagation by seed has several advantages and disadvantages. It is useful where variability is desired, or where variability is not important; and produces large numbers of easily stored and transported propagules (seeds). One of the obvious disadvantages, of course, would be a situation where a very uniform batch of offspring is desired. Another would be the time element. It is necessary to catch the flower(s) at just the right stage of maturity and successfully pollinate it. In addition, waiting for the seeds to mature and then growing a plant from seed to maturity in most cases takes much longer than starting from a leaf, stem or root cutting. In *Sarracenia, Nepenthes,* and *Byblis,* however, starting from seed is so far the only method of producing large numbers of plants. For *Drosophyllum,* it is the only reliable method of propagation.

Techniques of propagation will also be covered and will include information on the various types of seed treatments necessary to induce germination (the visible beginning of growth of the new plant). Some of the treatments are stratification (storage in a moist state under a given, usually low, temperature), treatment with various chemicals or hormones, etc. These treatments are necessary to overcome a physiological (biochemical) type of dormancy. In some cases, the type of dormancy is physical — that is, a simple physical barrier exists, such as an impervious seedcoat, that can be overcome by scarification (making the seedcoat permeable to water and air by breaking through the seedcoat by the use of strong chemicals, filing, sanding, etc.). In many cases, both physical and physiological dormancy exist concurrently.

Another less obvious disadvantage to sexual propagation would be the existence of inherent barriers to seed production. Two of these would be self-sterility and the dioecious state (separate male — *pollen* producing and female — *seed* producing plants). In the former, seed can be only produced by the application of pollen from a genetically distinct clone to the stigma of the flower of another genetically distinct clone. In other words,

if there were initially just two distinct plants from two seeds that were self sterile — we'll call them plants A and B — only a cross *between* plant A and B (or their descendents by asexual propagation) would produce fertile seed. If either plant were propagated asexually, the progeny of the original plant A *or* B would not produce seed if pollinated *within* all the progeny of either group. A good example would be *Drosera binata*. If one initially got one plant and asexually propagated any number of them, seed could not be produced even though pollen would come from "separate individuals." This may be the reason why some of you may not be able to produce seed of this species even though you may have more than one plant.

The dioecious state requires that both male and female plants be present and that both be in flower at the same time so that transfer of pollen from the male flower to the female flower be accomplished while the female is receptive. The genus *Nepenthes* is the only CP to have this characteristic. This is probably one of the reasons why *Nepenthes* are still relatively rare in cultivation and why there are not more hybrids with many more species. Most of the material in cultivation, specifically, named hybrids, has been propagated from cuttings and are of only one sex. Also, the process for making the plant flower at will has not been totally worked out. (See Botanist's Corner, CPN Vol. 6, Nos. 3 and 4.)

(To be continued)

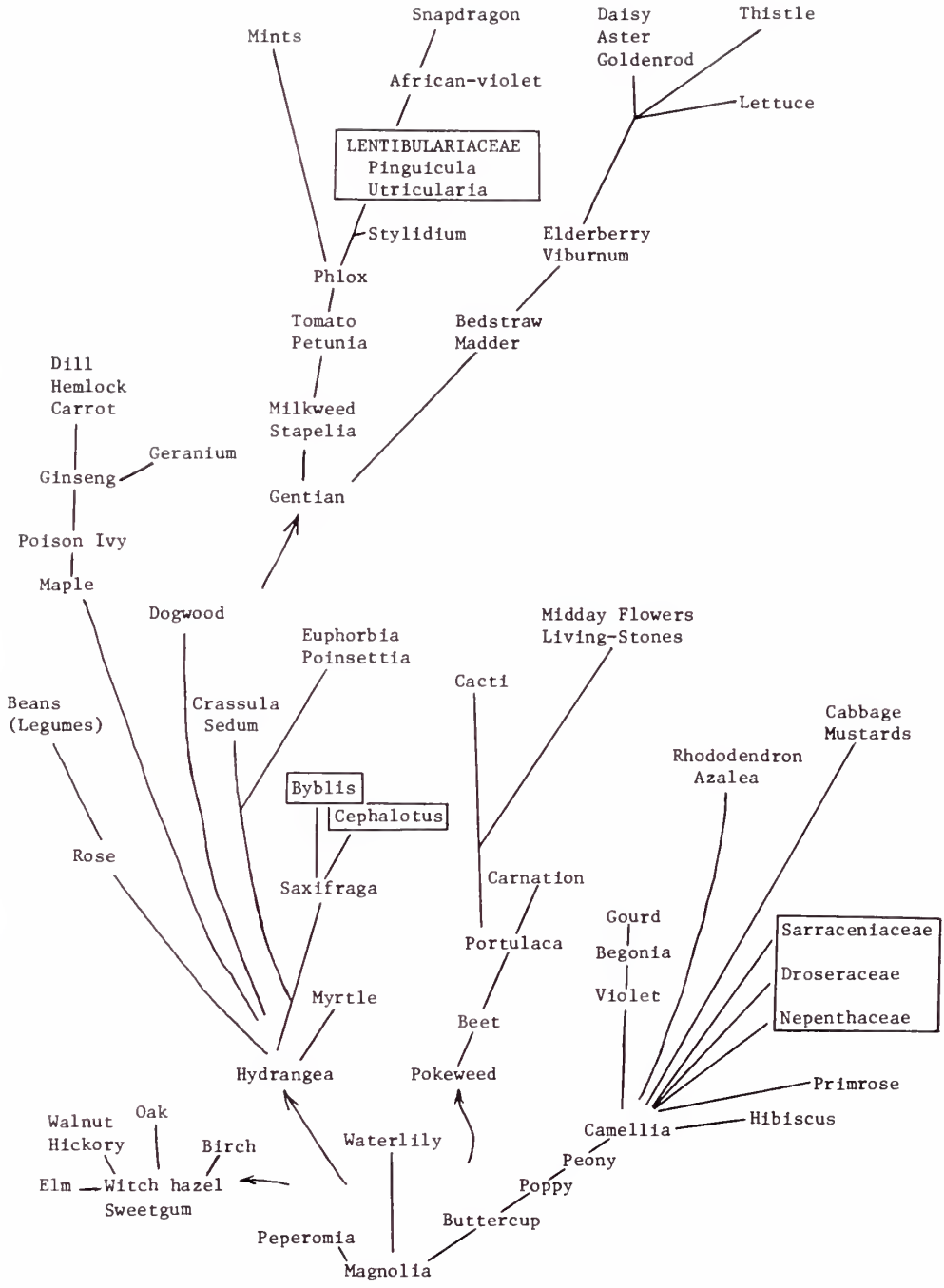
BOTANIST'S CORNER

by Larry Mellichamp

The Genera of Carnivorous Plants

The diagram shows a schematic representation of the possible evolutionary relationships of the flowering plants (excluding the lilies, grasses, orchids, and their relatives), indicating the positions of the carnivorous plants in the overall system. I have tried to use familiar plants in constructing this "evolutionary tree" to help you get some feeling for the diversity and pattern within this large group of flowering plants, which contains probably over 200,000 members. It will be noted that while some groups of CP are relatively closely related (the pitcher plants and sundews, for example), they still represent diverse adaptations and are found at widely separated places in the natural order of types. This is what is so interesting and inexplicable: why has the carnivorous way of life arisen at different points in such widely different plants? Being fairly complicated, as plants go, involving trapping mechanisms, leaf modifications, and the development of digestive enzymes it would seem that such adaptations would be unlikely to occur more than once or twice. But plants, being what they are, dynamic, evolving, adapting, and changing have been able to do some pretty weird and wondrous things in this complicated and unpredictable world.

Below is additional information about the Carnivorous Plants which several members have requested to see summarized again, and which I hope will prove useful and interesting to everyone.



An Evolutionary Tree of the Flowering Plants

FAMILY	GENUS/COMMON NAME	NUMBER OF SPECIES	GEOGRAPHIC RANGE	KIND OF TRAP
Sarraceniaceae	*Sarracenia* Pitcher plant	8-10	Eastern N. America	Passive/pitfall
	Darlingtonia Cobra plant	1	California, Oregon	
	Heliamphora Marsh Pitcher	6	Venezuela Guyana Highlands	
Nepenthaceae	*Nepenthes* Tropical Pitcher plant	±75	Tropics of Eastern Hemisphere	
Cephalotaceae	*Cephalotus* Australian Pitcher plant	1	S. W. Australia	
Droseraceae	*Dionaea* Venus Flytrap	1	N. & S. Carolina	Active/steel trap
	Aldrovanda	1	Warm areas of Eastern Hemisphere	
	Drosera Sundew	±130	Worldwide	Active sticky hairs
	Drosophyllum	1	Morocco, Portugal Spain	Passive/sticky hairs
Byblidaceae	*Byblis*	2	W. Australia	Passive/sticky hairs
Lentibulariaceae	*Pinguicula* Butterwort	±50	N. Hemisphere S. America	Active/flypaper
	Utricularia Bladderwort	±170	Worldwide	Active/mousetrap
	Polypompholyx	2	Australia	
	Genlisea	±14	Brazil, W. African tropics	Passive/lobster trap

NOTE: The above synopsis is slightly modified from a masters thesis by John Lindquist, University of Wisconsin, 1975, "Bacteriological and Ecological observations on the northern Pitcher Plant, *Sarracenia purpurea* L.". Lindquist acknowledges as sources Shetler (1972), Lloyd (1942), and Ziemer & Mazrimas (1974). The evolutionary tree is based on principles presented in Cronquist (1968).

Pronunciations of carnivorous plant genera:

Sarracenia (sĕr-ă-sē-nĭ-ă)
Darlingtonia (dăr-lĭng-tō-nĭ-ă)
Heliamphora (hē-lĭ-ăm-fōr-ă)
Nepenthes (nē-pĕn-thēz)
Cephalotus (sĕf-ă-lō-tŭs)
Dionaea (dī-ō-nē-ă)
Aldrovanda (ăl-drō-văn-dă)
Drosera (drŏs-ĕr-ă)
Drosophyllum (drŏs-ō-fĭl-ŭm)
Byblis (bĭb-lĭs)
Pinguicula (pĭn-quĭck-ū-lă)
Utricularia (ū-trĭk-ū-lā-rĭ-ă)
Polypompholyx (pŏly-pŏm-fō-lĭcks)
Genlisea (gĕn-lĭ-sĭ-ă)

References cited:

Cronquist, Arthur. 1968. The Evolution and Classification of Flowering Plants. Houghton Mifflin Co., Boston. 396 pp.

Lloyd, F. E. 1942. The Carnivorous Plants. Chronica Botanica Co. Reprinted 1976 by Dover Publications. 352 pp.

Shetler, S. G. 1972. Carnivorous Plants, pp. 938-939. *In* Encyclopedia Britanica, Vol. 4.

Ziemer, R. & J. Mazrimas. 1974. World Carnivorous Plant list. Carnivorous Plant Newsletter, Spec. Proj. Suppl. 1.

Next in the Botanists Corner we will begin a series on the discovery of the various CP genera, and the derivation and meanings of their scientific and common names.

Review of Recent Literature

Colombo, P. M., Rascio, N. Ruthenium red staining for electron microscopy plant material. J. Ultrastruct. Res. 60(2): 135-139 (1977).

Drosera spathulata mucilage was intensely stained using ruthenium red in glutaraldehyde and osmium tetroxide as seen by the electron microscope.

Dzwonko, A., Plazinska, J. Decline of selected water plants in the vicinity of Krakow during the last 150 years. Zesz. Nauk. Uniw. Jagiellonsk. Pr. Bot. 5, 134-148. 1977. In Polish with English summary.

Aldrovanda vesiculosa is one of the species of extinct plants from the Oxbow lakes of the Vistula River near Krakow, Poland. The authors discuss the causes of this and some conservation measures.

Folkerts, George W. 1977. Endangered and threatened Carnivorous Plants of North America. pp. 301-303 *In* Chillean T. Prance & T. S. Elias, editors. Extinction is Forever: Threatened and Endangered species of plants in the Americas and their significance in ecosystems today and in the future. New York Botanical Garden, New York. [Folkerts' address for reprints: Dept. of Zoology-Entomology, Auburn University, Auburn, Alabama 36830.]

Brief discussion of each species of CP (or genus for larger groups) and its status as an endangered plant. All species of *Sarracenia* and *Darlingtonia* are discussed. Of these, *S. oreophila* and *S. alabamensis* ssp. *wherryi* (= *S. rubra* ssp. *wherryi*) are considered by the author to be threatened; while *S. alabamensis* ssp. *alabamensis* (= *S. rubra* ssp. *alabamensis*) and *S. jonesii* (= *S. rubra* ssp. *jonesii*) are considered to be endangered. ENDANGERED implies that a species is on the verge of becoming extinct unless measures are taken to preserve it. THREATENED means that the numbers of species or populations are critically low so that the species is

likely to soon become endangered. *S. rubra* ssp. *rubra* is not considered to belong on an endangered threatened list. While *Dionaea* is considered threatened, due mainly to habitat destruction and purported over-collecting, it is far from endangered. No *Drosera* are considered threatened or endangered.

Because of the inconspicuous nature of many *Utricularia* species, it is difficult to know the status of each species. None are considered threatened or endangered. In the genus *Pinguicula, P. ionantha* is considered to be threatened. *P. plamifolia* is mentioned as being included on the Smithsonian E & T Plant List, but the present author considers it unnecessary to include it on such list. Finally, the article discusses factors affecting the survival of the southeastern US Carnivorous Plants, which are: Lumbering, agricultural drainage, farm pond construction, reduction of fire and ecological succession, over-collecting and introgressive hybridization. As always, he concludes by emphasizing that the only way to preserve species is to preserve appropriate habitats in which they occur and to understand proper management. He disagrees totally with the idea that because a great deal of cultivated material exists, that we no longer need to worry about wild populations.

Hardin, James W. 1977. "Vascular Plants," pp. 56-142.
In J. E. Cooper, *et al.* (editors) Endangered and Threatened Plants and Animals of North Carolina: Proceeding of a Symposium. N.C. State Museum of Natural History, Raleigh.
"This publication [available below as a reprint] includes a discussion of the concept of rarity, status categories, and the rationale for the priorities assigned to them. The 410 rare species of native vascular plants in North Carolina are listed and their status indicated. The 91 species considered of greatest concern are described briefly, and information given on distribution, habitat, status, and important references. Over half of the 91 species are illustrated with line drawings.
"This information on endangered and threatened plants is designed to help biologists, resource managers, teachers, conservationists, and the general public become better informed regarding the general concept and terminology pertaining to endangered species."
Of the 91 plants of greatest concern, are listed *Dionaea*, and *Sarracenia rubra* (ssp. *rubra*). In addition, *Drosera filiformis* is listed as endangered in N.C.; and *Utricularia geminiscapa* is listed as endangered in N.C.
Reprints of this Chapter on *PLANTS* is available for $2.50 (includes postage) from: Bookstore, University of North Carolina at Charlotte, UNCC Station, Charlotte, N.C. 28223.

Heslop-Harison, Y. 1978. Carnivorous Plants. Scientific American. Feb., 104-115.
An excellent review of the CP glandular anatomy and physiology of the digestive glands with emphasis and scanning electron micrographs on *Pinguicula*. A table with the known enzymes detected for each genus is given.

Kologiski, Russell L. 1977. The Phytosociology of the Green Swamp, North Carolina. Technical Bulletin No. 250, North Carolina Agriculture Experiment Station.
[Kologiski's current address: U.S. Fish and Wildlife Service, Northern Prarie Wildlife Research Center, Jamestown, North Dakota.]
"This report is a description of the vegetation and habitat of one of the most biologically unique natural areas in North Carolina. Much of the study area is characterized by organic soils, long hydroperiods [standing water], frequent

fires, and a dense, semi-evergreen, shrubby vegetation type known as pocosin. The area achieved national recognition when in May 1974 the Secretary of the Interior designated the Green Swamp as a Natural Landmark as prescribed by the National Park Service. In July 1977, approximately half the study area (13,850 acres) was deeded to the Nature Conservancy by the Federal Board Co., Inc. It is hoped that this study will aid in the preservation and management of this and similar habitats and, also, give rise to future research aimed at understanding the complexities of this habitat type."

Of course, the Green Swamp contains the largest no. of CP genera growing together of anywhere in the world: *Dionaea, Drosera, Utricularia, Pinguicula,* and 4 species of *Sarracenia.* While CP *per se* are not discussed in the report, they are mentioned as species occurring in specific habitats, and the description of the habitats and the general area are worth the reading and understanding of this report.

Lindquist, John Arthur. 1975. "Bacteriological and ecological observations on the northern pitcher plant, *Sarracenia purpurea* L." Masters Thesis, University of Wisconsin, Madison. x + 215 pp.

Studies were made on the purple pitcher plant in the lab and in the field (in bogs near Cambridge and Drummond, Wisconsin) to determine what types of bacteria are found in the pitcher fluid and their relation to the digestive action of the fluid. The pH of the fluid in the field varied from 3.1 to 7.2, and carbon dioxide was considered important in maintaining the acidity. The microbial flora of the pitcher fluid were generally typical for plant and aquatic habitats. Proteolytic and chitinolytic bacteria were isolated. The digestion of insects appeared to be largely mediated by the bacteria. This study resulted in an extensive list of isolated bacteria and their biochemical properties. The micro-habitat of the pitcher fluid is a very complex mixture of chemicals and reactions. The thesis also contained an excellent survey of previous work on digestion in the genus *Sarracenia.*

McCollum, Jerry L. & D. E. Ettman, Georgia's Protected Plants. [Available from Resource Planning Section, OPR, Endangered Plant Program, Room 702, 270 Washington Street SW, Atlanta, Georgia 30334. No price is mentioned.]

This is a very nice booklet (64 pages printed one side only(along the lines of the North Carolina Rare Plants publication mentioned above. 58 species are listed, with detailed information on their distribution (a map for each), their status (whether rare, threatened, endangered, etc.), and a drawing is provided for each. In adition, there is a page of color photos, one of which is *Sarracenia minor.* The CP listed are *Sarracenia flava* (threatened), *S. leucophylla* (threatened), *S. minor* (threatened), *S. psittacina* (threatened), *S. purpurea* (endangered), and *S. rubra* (endangered).

Mandossian, A. J. 1966. Germination of seeds in *Sarracenia purpurea.* Mich. Bot. 5:67-79.

Summary: Dormancy of *Sarracenia purpurea* seeds was broken by pre-chilling to 50°F. Treatment by sulphuric acid injured embryo. The substrate (sphagnum, marl, blotter) had no appreciable effect on germination.

Peak germination in the shortest possible time (9-15 days) was achieved in constant light at 28°C, with 1-3 month prechiling, in moist agent.

In absence of pre-chilling, there was practically no germination over any substrate, with any moistening agent, ex-

cept in alternating light and dark in alternating temperature (light at 22°C, 8 hrs. and darkness at 5°C, 16 hours), in which case germination required 39 days.

Factors were discused which might attribute to the lack of seedlings in a given locality.

Mandossian, Adrienne J. 1965. Plant associates of *Sarracenia purpurea* (pitcher plant) in acid and alkaline habitats. Michigan Botanist 4: 107-114.

"It would appear from the study of these five bogs of central lower Michigan that *Sarracenia purpurea* grows over a variety of substrates (semi-aquatic, soft organic soil, and hard marl [lime]), over a pH range of 5.2 to 8.9, that it forms no consistent association with any single plant species, and that within the range examined its reproductive vigor is not determined by the reaction [pH] of the substrate.

Mandossian, A. J. 1966. Variations in the leaf of *Sarracenia purpurea*. Mich. Bot. 5:26-35.

"In view of the above observations it seems reasonable to conclude that for *Sarracenia purpurea*, which lives mainly in open sunny places, light intensity is an important factor in normal development of its leaf form, and that low intensity of illumination is a major cause for the production of flattened leaves."

Small, J. G. C., Onraet, A., Grierson, D. S. and Reynolds, G. Studies on insect-free growth, development and nitrate-assimilating enzymes of *Drosera aliciae* Hamet. New Phytologist 79 (1):127-134 (1977).

The above *Drosera* species grown from seed showed better growth with ammonium chloride and ammonium nitrate than with sodium nitrate. The sodium nitrate plants grew better at pH of 4.0 while the plants grown on the ammonium salts grew better at higher pHs. Plants that were grown on a nitrogen-free medium were fed cheese and were little affected by increasing pH. Flowers and seed were produced by all the plants on any of the treatments. The following enzymes were demonstrated in the roots and leaves of control and treated plants: nitrate and nitrate reductase, peroxidase, glutamate dehydrogenase, glutamate synthase and glutamine synthetase.

THE CPN SHOP

Once a year we provide CPN members the privilege of ordering CP books written by Japanese authors. All except the one indicated are written in Japanese. They are generously interspersed with excellent pictures both in color and B&W. While a limited supply lasts, we offer the following books at prices that include all postage (overseas and domestic). Please send your check or money order to J. A. Mazrimas before May 1, 1978. The books will be ordered at that time, and you should expect a delay of two to three months before you receive the books you ordered. All books will be sent by surface mail.

Author	*Title*	*Pages*	*Price*
Shimizu	The Mystery of Carnivorous Plants	54	$3.75
Suzuki	Insectivorous Plants (Cult. and Coll.)	168	2.75
———	Aldrovanda vesiculosa at Hanyu-City	32	5.50
Kondo	Carnivorous Plants	292	8.75
Kurata, S.	Nepenthes of Mt. Kinabalu (Eng.)	80	5.00
Asashi	Plants of the World #9 *(Utricularia)*, #46 *(Cephalotus)*, #64 *(Drosera, Nepenthes, Sarracenia)*		2.25 ea.
	Garden Life, Vol. 7, 1977 (Magazine)		4.40

REFERENCE BOOKS

Not available through CPN. Order direct from publisher or your local bookshop.
* = books intended primarily for children.

Title	*Author*	*Publisher*	*Source — Cost*
Insectivorous Plants	Charles Darwin	John Murray	2nd Hand Bookstores
Plants of Prey in Australia	Rica Erickson	Univ. of W. A. Press 1968	World Insectivorous Plants Rt. 3, Box 338S, Arroyo Grande CA 93420. Cloth, $12.00 ppd.
Carnivorous Plants	F. E. Lloyd	Chronica Botanica 1942 & Dover Pub.	2nd Hand Bookstores Soft cover (1976) $4.50
Carnivorous Plants	Randall Schwartz	Avon Books (soft cover) 1975	959 Eighth Ave., New York NY 10019. $1.25
Carnivorous Plants	Anabel Dean	Lerner Publications	241 First Avenue Minneapolis, MN 55401 $3.95
The World of Carnivorous Plants	J. and P. Pietropaolo	R. J. Stoneridge 1974	Peter Paul Nurseries $6.30
Insect-Eating Plants*	L. and G. Poole	T. Y. Crowell 1963	666 Fifth Avenue New York, NY 10003 $4.50
Carnivorous Plants*	John F. Waters	Franklin Watts, Inc., 1974	845 Third Avenue, New York, NY 10022 $3.90
Plants that Eat Animals*	Linda Bentley	McGraw-Hill Book Company 1968	1221 Ave. of Americas New York, NY 10036 $4.72
CP of the U.S. and Canada	D. E. Schnell	John F. Blair, Publisher 1976	1406 Plaza Dr. SW Winston-Salem, NC 27103 $19.95 (+35¢ postage)
Cultivating Carnivorous Plants	Allen Swenson	Doubleday & Co. 1977	Garden City, NY 11535 $7.95

INTERNATIONAL BOOKFINDERS are the people to contact as a source of books that are out of print. They circulate a newsletter around the country to used book stores listing books that are being sought. When they locate the book, they contact you with price information plus their service fee. You are not obligated to buy the book if the price is too excessive for you. They are a reputable firm. The address: International Bookfinders, Inc., P. O. Box 1, Pacific Palisades, CA 90272.

SOURCES

We are offering an update of the annual list of carnivorous plant commercial sources. It is our experience that spring is the best season to order these plants. *We do not endorse any of these sources.* Those sources who have volunteered a letter stating that all stock is propagated rather than scavenged from the field are listed first with an asterisk (*).

Name and Address	*Catalogue*	*Genera*
Sun Dew Environments * P.O. Box 111 Denver, NY 12421	50¢	*Dionaea, Drosera, Sarracenia, Pinguicula, Darlingtonia, Utricularia*
World Insectivorous Plants * Rt. 3, Box 338S Arroyo Grande CA 93420	50¢	*Dionaea, Drosera, Cephalotus, Utricularia, Pinguicula, Nepenthes, Byblis liniflora, Sarracenia*
Carolina Exotic Gardens Box 1492 Greenville, NC 27834	75¢	*Sarracenia, Darlingtonia, Dionaea, Nepenthes khasiana, Drosera, Pinguicula, Utricularia*
Peter Paul Nurseries Darcey Road Canandaigua, NY 14424	25¢	*Dionaea, Drosera, Sarracenia, Pinguicula, Darlingtonia, Utricularia, Nepenthes* seed
Arthur E. Allgrove North Wilmington, MA 01887	25¢	*Dionaea, Sarracenia, Pinguicula*
Edelweis Gardens 54 Robbinsville-Allentown Rd. Robbinsville, NJ 08691	35¢	*Dionaea, Drosera, Sarracenia, Darlingtonia, Nepenthes*
Tote Em in Zoo Route 2, Box 368 Wilmington, NC 28401	25¢	*Drosera, Sarracenia, Pinguicula*
Marcel Lecoufle 5 Rue de Paris 94470 Boissy-Saint-Leger France	Inquire	*Drosera, Dionaea, Sarracenia, Nepenthes, Darlingtonia, Pinguicula*
Harold Welsh Black Copper Kits 266 Kipp St. Hackensack, NJ 07601	25¢	*Dionaea, Drosera, Sarracenia, Darlingtonia*
Jerry Horne 10195 Southwest 70th St. Miami, FL 33173	Inquire	*Nepenthes*

WANT ADS

Garry Nolan, 20 Stratford Court, Windsor, CT 06095. (WB) Plants or seed of the following: Drosera regia, D. linearis, D. cuneifolia, Heliamphora, Drosophyllum; Nepenthes rooted cuttings. (W) Information on culture of D. glanduligera.

Philip Thomas, Route 4, 144 Monticello Road, Weaverville, NC 28787. (TS) Plants: Drosera binata, D. capensis, D. spathulata, D. capillaris, D. x nagamoto, D. natalensis, Sarracenia flava, S. minor (rhizomes), S. purpurea venosa, Utricularia subulata. Seed: Nepenthes mirabilis, S. rubra jonesii, D. intermedia. Small plants: filiformis tracyii. Small seedlings: Dionaea muscipula. (WTB) Nepenthes ssp. (plants or cuttings), N. veitchii (plants — P, cuttings — C, or seed — S), N. lowii (PCS), tuberous droseras (PS, tubers), pygmy droseras (PS, gemmae), S. purpurea heterophylla (PCS), Heliamphora ssp. (PSC), Aldrovanda (PSC), Genlisea ssp. (PSC), Polypompholyx tenella (PSC), D. hamiltoni (PSC), D. schizandra (PSC), Roridula dentata (PS), D. linearis (PSC), Byblis gigantea (PC), Drosophyllum lus. (P), S. purpurea x psittacina ("x courtii") (PSC), P. lutea (PS), P. caerulea (PS), U. olivacea (PS), P. villosa (PS), P. pumila (other than blue flowers) (PS), non-U.S./Canadian Pinguicula ssp. (PSC if feasible), multihybrid Sarracenia (PC), S. rubra ssp. alabamensis (PSC), S. rubra ssp. wherryi (PSC), Appalachian Mountain CP (PSC), S. psittacina (S), N. American Utricularia ssp. (other than U. subulata) (PS), Sarracenia seed in quantity, N. bicalcarata (SCP), S. leucophylla ssp. alba, Aldrovanda, seed of tuberous Drosera, seedlings of any Sarracenia sp. or hybrid, Genlisea, complex and/or introgressive hybrids of Sarracenia (plants or rhizome cuttings), D. x capulata (WB) Reprints of articles in other botanical journal re: CP.

Paul Ware, 50 Oatlands St., Wentworthville, NSW 2145, Australia. (WTB) Sarracenia hybrids (seed or rhizome cuttings).

When submitting Want Ads, please be sure to print clearly for best results and to eliminate mistakes. Please circle the correct letter before each item (Want, Trade, Sell or Buy). Want ads are limited to carnivorous plants, terrariums, greenhouses and moss. There is a charge of ten cents per item, with no limit to the number of items you may submit per issue.

Send coin or check along with the form to:

Arboretum, Want Ads
California State University
Fullerton, CA 92634

PLEASE PRINT CLEARLY. CIRCLE CORRECT LETTER BEFORE EACH ITEM.

NAME .....
STREET .....
CITY & ZIP .....
W T S B 1) .....
W T S B 2) .....
W T S B 3) .....
W T S B 4) .....
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SPECIAL NOTICE

In the December, 1977, issue of CPN it was announced that all subscribers would soon receive a colorful brochure describing a limited edition reprint of a fine painting of native North Carolina carnivorous plants in their natural habitat. These are being mailed now; we have sent them out to approximately 100 people so far, in alphabetical order. Do not despair. You will get yours in time. The Christmas rush delayed our initiating the mailing, but they are going out rapidly now. I'm sure each of you will agree that this is a fine piece of artwork and will want to consider ordering one. Several subscribers have already sent in their orders. If I can be of any help in providing information to anyone, please let me know. (Larry Mellichamp, Dept. of Biology, UNCC, Charlotte, NC 28223).

JOE MAZRIMAS is one of the co-editors and co-founder of *Carnivorous Plant Newsletter.* Ever since he was a young man, he was intensely interested in growing plants as a hobby and gained all his experience with a wide variety of genera. As his hobby matured, he eventually became interested in growing tropical plants. At any one time you can find him working his banana tree, pineapple or papaya, and he seriously considered raising the greenhouse roof for the fast-growing coconut palm. Plants that move also interested him, and he began growing the well-known sensitive plant and telegraph plant.

About 15 years ago, he purchased his first *Dionaea* plant which lasted about two weeks because it rotted away. He went to the library to find out why and discovered that he was over-watering it and not giving it enough light. Purchase of the second *Dionaea* bulb proved to be more successful with a change in conditions so that his plant flowered the following spring.

This experience of growing a quick-moving and hungry plant moved Joe to find out more about the other CP during his frequent library excursions. It wasn't too long before his collection of these plants extended to pitcher plants, sundews, etc., so that now he is presently growing about 200 different species and varieties.

Joe's hobby (or is it an avocation?) keeps him pretty busy with not only growing the plants but also trying to keep up with his research with seed germination, new propagation techniques and acquiring new species in cultivation. As a biochemist, he tries to apply his research experience in discovering new methods for rapidly getting seed to germinate and leaf cuttings to sprout new buds.

The newsletter was born out of the fact that it was hard to find reliable information on carnivorous plants which a grower would need for individual genera. As this periodical matures, we will be dealing with individual plants and their needs. Joe's experience gained over the last decade and a half in growing these plants will prove to be invaluable in seeing that project get started.

Nepenthes X *dicksoniana,* an artificial hybrid between *N. veitchii* and *N. rafflesiana,* with a pair of hand clippers inside the pitcher to illustrate the size they can reach. The clippers measure about 8 inches/ca 20 cm long. This plant is also a part of the CP collection at California State University, Fullerton.

Photo by L. Song